INVERSION OF MOISTURE CONTENT 011' FOREST CANOPY AND FLOOR FROM SAR DATA

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Several scattering mechanisms contribute to the total radar backscatter cross section measured by the synthetic aperture radar (SAR). These arc volume, scattering, trunk-ground double-bounce scattering, branch-ground double-bounce scattering, and surface scattering. All of these mechanisms result in measurements which arc directly related to the dielectric constant of forest components responsible for that mechanism, and hence to their moisture content. Hence, in principal, it is possible Lo retrieve the moisture content from multifreuqency polarimetric SAR data, such as obtained from the NASA/J PI, AIRSAR. Sine.c including all of the above mechanisms in the estimation problem is not possible due to the large number of unknown parameters they introduce, each of them needs to be considered individually. Here, wc discuss two cases: the case where the radar backscatter is almost entirely due to volume scattering, and the case where the trunk-ground double-bounce mechanism dominates. For the volume scattering case, wc identify the real and imaginary parts of the dielectric constant of the branch layer components as the unknowns to be estimated. For the trunk-ground double-bounce case, we will identify the complex dielectric constant of trunks and the complex dielectric constant of ground as the unknowns. Forest floor roughness as well as trunk height, diameter, and density will be assumed known. Wc will also use empirical relationships between the real and imaginary parts of the trunk dielectric constant to reduce the number of unknowns. The estimation algorithm is then carried out as follows: parametric relations between the radar backscatter (trunk-ground scattering or volume sattering as appropriate) and the unknowns arc derived by fitting]Iifll]cl'-ordcr polynomials to the numerical results generated from a discrete-component forest scattering model. The unknowns are then inverted, or estimated, through a nonlinear optimization technique applied to polarimetric SAR data using the parametric models. This algorithm is first tested using synthetic data. It is then applied to AIRSAR data from a young jack pine stand for volume scattering case, and an old jack pine stand for the double-bounce case, both in the BOREAS southern study area. For each stand, a classification algorithm was used to identify the corresponding dominant scattering mechanism. Extensive ground-truth data exist for this area. The estimation results are compared to the dielectric constant and moisture content measurements for these stands, where it is seen that good agreement exists between the two.

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